

The Nise Formation on the Halten Terrace, offshore mid-Norway

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Objective and Background

The objective of this work is to propose a depositional model of the Upper Cretaceous (Campanian) Nise Formation in the Halten Terrace area offshore mid-Norway.

The Nise Formation was originally defined as “claystone interbedded with carbonate and sandstone stringers”².

The Nise Fm. on the Halten Terrace has not been extensively described, but previous regional studies have suggested various depositional settings, such as open marine², mud prone slope⁴, open marine with shelf and slope affinities³ and deeper water¹.

As previous interpretations suggest various environments, a new look is needed.

Sedimentological logs were made for five cores containing parts of the Nise Fm. (Fig. 1). The results are described in terms of lithofacies and ichnofacies.

Results and Interpretation

Nine facies are defined from the described cores (Table 1 on slide 2).

Halten Terrace

- Cores 6407/1-4 and 6407/4-1 (upper Nise Fm.) are composed exclusively of facies 1A (Table 1, Fig. 2A), whereas core 6407/2-1 (lower Nise Fm.) consists of facies 1A and 1B (Table 1, Fig. 2A,B).
- Facies 1A and the associated ichnofacies indicate deposition below or close to the storm wave base (Fig. 3), where the sand was deposited by suspension from storm-induced rip currents, and mud from fair-weather suspension.
- The laminated mudstone and associated ichnofacies of facies 1C in core 6407/2-1 are possibly associated with a deeper part of the shelf.

Nyk High and Vestfjorden Basin

- Cores 6707/09-U-01 and 6610/3-1 are dominated by sediment gravity flow deposits, such as turbidites (facies 2, 3, 5, 6, 7, Table 1), debrites (facies 4, Table 1) and slumps (facies 8, Table 1), while core 6610/3-1 also contains slides (facies 9, Table 1) and storm deposits (facies 1B, Table 1).
- The ichnofacies associated with the sediment gravity flow and storm deposits in cores 6707/09-U-01 and 6610/3-1 indicate either a distal shelf or a basin floor setting.

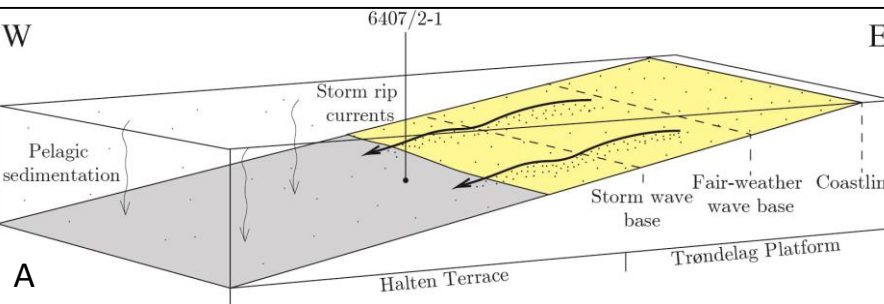


Fig. 3. Suggested conceptual depositional model for the Nise Formation on the Halten Terrace during the Campanian. (A) The lower Nise Fm. deposited in a deeper part of the shelf and (B) the upper Nise Fm. deposited below and close to the storm wave base.

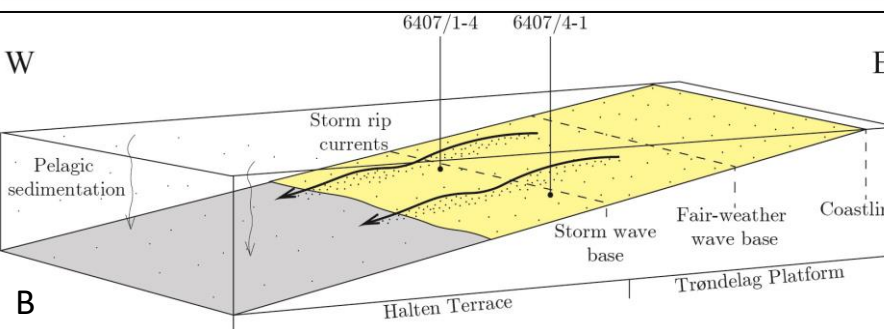


Fig. 1. Location of the studied cores. NH= Nyk High, VB=Vestfjorden Basin, HT=Halten Terrace, TP=Trøndelag Platform. Modified from NPD Factpages https://factmaps.npd.no/factmaps/3_0/.

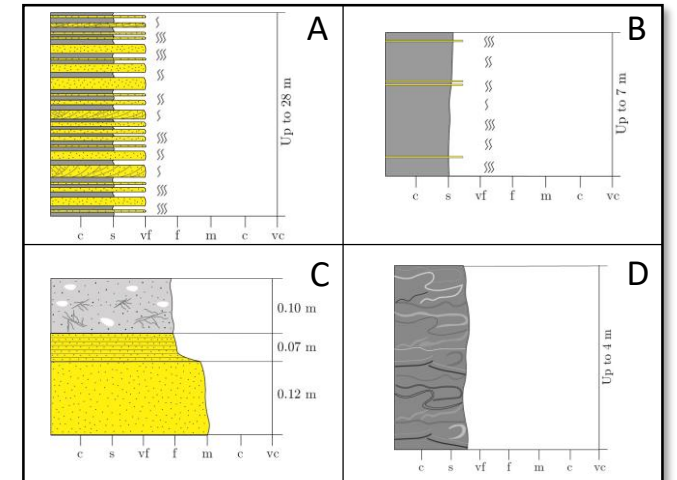


Fig. 2. Examples of observed facies and facies associations. (A) Bioturbated heterolithics, (B) laminated mudstone, (C) low-density turbidite with debrite, (D) slump.

Conclusion

The Nise Formation on the Halten Terrace was deposited in a storm-dominated shelf setting, below or close to the storm wave base. Current results challenge previous interpretations that suggest slope and deeper water.

The ichnofacies of the Vestfjorden Basin and Nyk High cores indicate deposition in the offshore transition, offshore or on the basin floor.

Further work: Can the turbidite system in the Vestfjorden Basin core be linked to the storm-dominated Norwegian shelf during the Late Cretaceous?

References

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Table 1. Overview of the identified facies. The coin is 2.1 cm. in diameter.

	1: Bioturbated alternating mudstone and sandstone/siltstone										
Facies	1A: Bioturbated Heterolithics	1B: Alternating Mudstone and Sandstone	1C: Laminated Mudstone	2: Fissile Shale	3: Structureless Sandstone	4: Poorly Mixed Muddy Sandstone	5: Banded Sandstone	6: Laminated Sandstone	7: Rippled Sandstone	8: Distorted Mudstone	9: Disturbed Alternating Mudstone and Sandstone
Description	Wavy bedded, densely bioturbated, very fine-grained sandstone and mudstone	Densely bioturbated alternating mudstone and sandstone	Pinstriped with siltstone, densely bioturbated, shell laminae.	Shale with occasional pinstripes of silt- and sandstone. Sparsely bioturbated	Massive sandstone, ungraded or normally graded, water escape structures	Chaotic mix of mud- and sandstone, mudclasts and rock fragments	Alternating sand- and mudstone. Sandstone loading into the mudstone	Sandstone with thick darker planar laminae	Sandstone with thick darker ripple laminae with curved tops and foresets	Mudstone with distorted sandstone laminae, rock fragments, imbrication	Microfaulted alternating mud- and sandstone. Shear bands cross-cutting the laminae
Ichnofacies	Cruziana	Cruziana Nereites	Cruziana	Cruziana Nereites		Cruziana Nereites	Cruziana Nereites			Cruziana Nereites	Cruziana Nereites
Interpretation	Suspension settling from storm rip currents and background sedimentation			Suspension settling of pelagic and/or turbidite muds	Rapid suspension fallout from turbidity current	Cohesive freezing of debris flow	Shear sorting of sand grains and clay floccules	Traction sedimentation from turbidity current	Traction sedimentation from turbidity current	Frictional freezing from slumping	Frictional freezing from sliding
Photo											
Sketch											